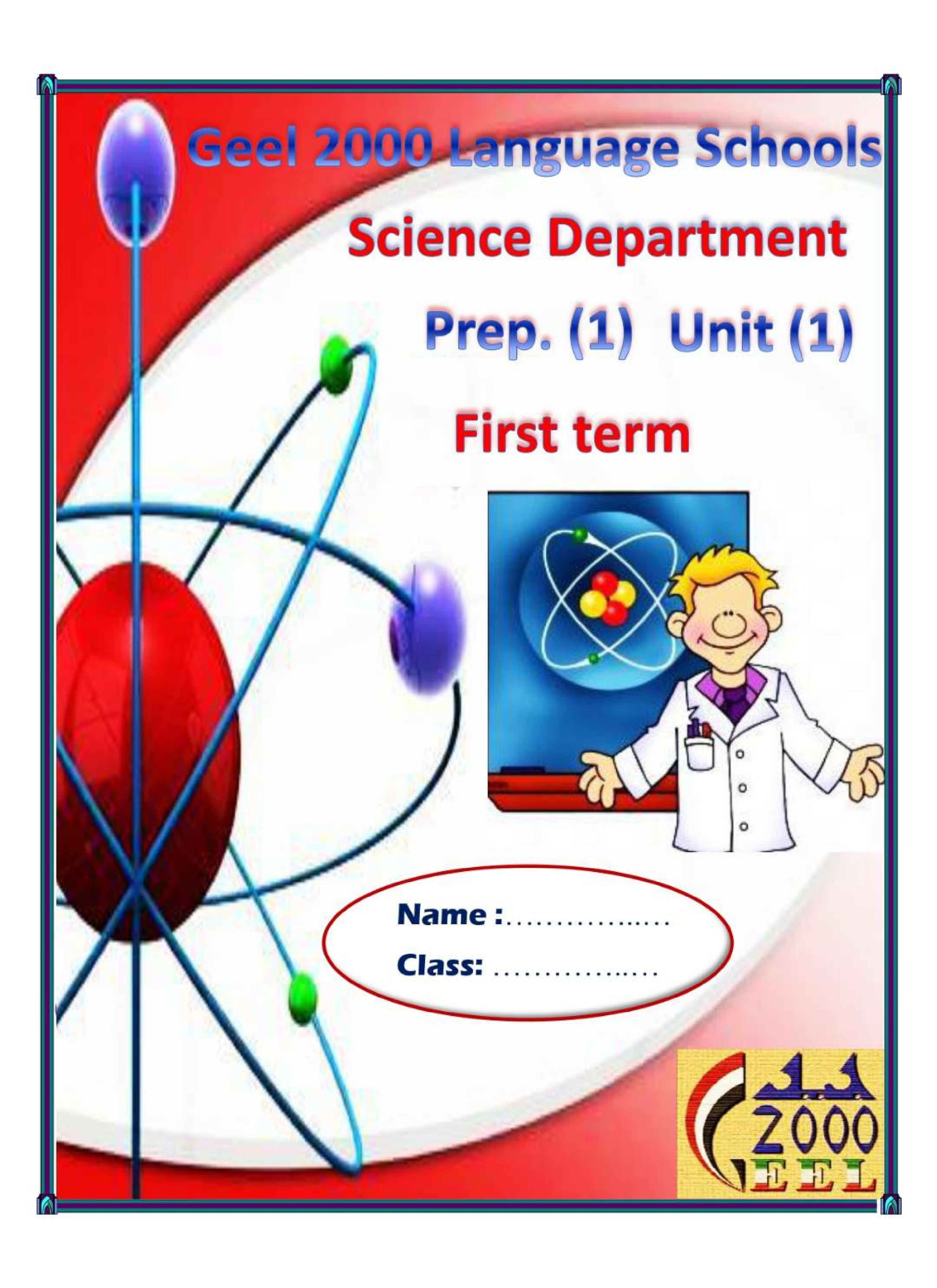

Geel 2000 Language Schools
Science Department
Prep. (1) Unit (1)
First term
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Class: ....
2000
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LESSON (1)

Atomic Structure



Matter : Everything that has volume and mass.

Matter → consists of **Molecules** → consists of **Atoms.**

Ex: limestone rock consists of calcium carbonate.

Limestone rock

Calcium carbonate matter

consistis of

Calcium carbonate molecules

every molecule consits of

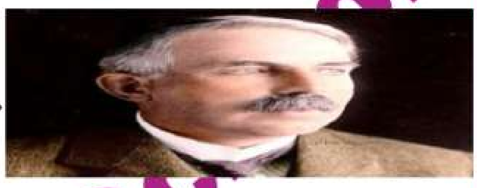
Atoms



Atom is the building and structure unit of any matter.



- **Dalton** is the scientist who developed the first scientific theory about the atom.
- He stated that atoms are indivisible.



- **Rutherford** (1909) is the first scientist who made the first experimental model of the atom.

Structure of the atom

Nucleus

*At the center of the atom.

* It contains protons & neutrons

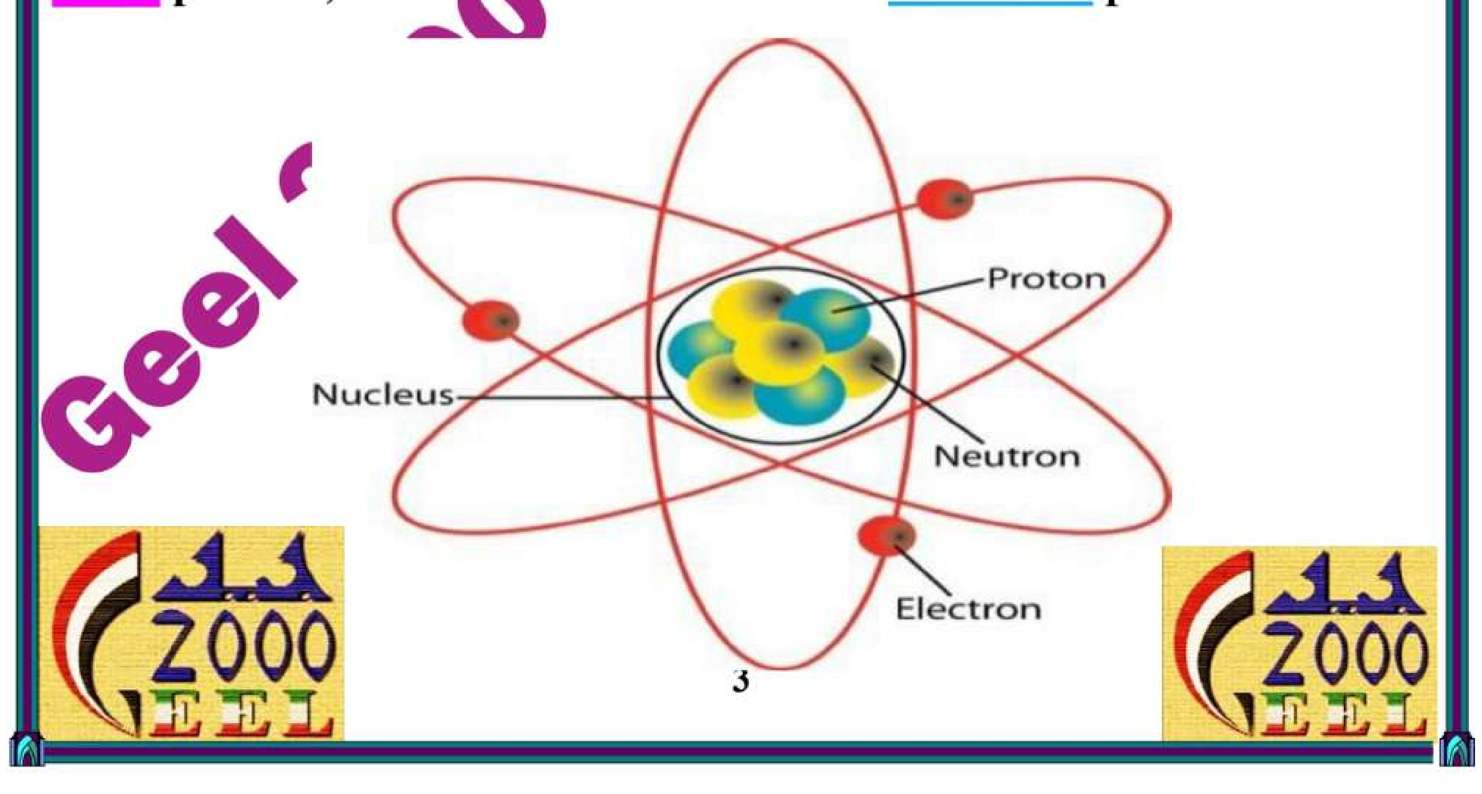
- **Protons:** positively charged particles (+ve).
- **Neutrons:** neutral particles (no charge).

Electrons

*Revolve around the nucleus at high speeds in energy levels.

-They are negatively charged particles. (-ve).

Note : protons, neutrons and electrons are subatomic particles.



- **Atoms are incredibly small (you can't see them with your eyes).**
- **If we represent the size of an atom to the size of a baseball field, the volume of the nucleus is represented by the size of a pin head in the middle of the field.**



Subatomic particle	Symbol	Relative Charge	Mass (u)	location
Proton	P^+	+1	1	Inside nucleus
Electron	e^-	-1	1/1836	In energy level around the nucleus
Neutron	n^0	0	1	Inside nucleus

Notes:

1-The charge of a proton is equal in magnitude to the charge of an electron, but differs in charges type.

2-The masses of subatomic particles are measured in atomic mass units (U).

3-The mass of electrons is negligible compared to the mass of protons or neutrons.

4- The number of electrons is equal to the number of protons ,so The atom is electrically neutral at ordinary state.

Don't FORGET!

Give reason:

1-The mass of the atom is concentrated in the nucleus.

-Because the mass of electrons is very small compared to the mass of protons or neutrons within the nucleus.

2- The atom is electrically neutral at ordinary state.

-Because the number of negative **electrons** is **equal** to the number of positive **protons**.

Some elements and their symbols

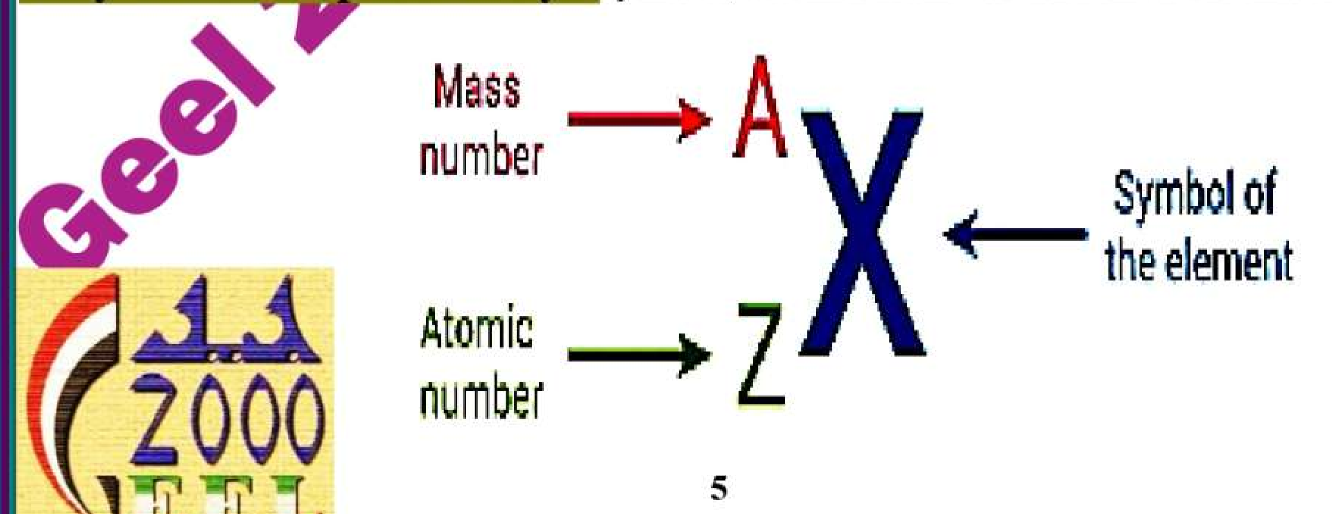
Element's name in English	In Latin	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Copper	Cuprum	Cu
Iron	Ferrum	Fe
Carbon	Carbo	C
Nitrogen	Nitrogenium	N
Chlorine	Chlorum	Cl
Chromium	Chromium	Cr

-The element's symbol may be:

1- One capital letter (such as H , N ,O) .

2- Two letters: the first is Capital and the second is small (such as Na, Fe, Cl).

-Any element represents by: symbol, atomic number and mass number.





Examples of Symbols of Some Famous Elements

Element	Symbol	Element	Symbol	Element	Symbol
Hydrogen	H	Potassium	K	Iodine	I
Helium	He	Magnesium	Mg	Carbon	C
Mercury	Hg	Lithium	Li	Calcium	Ca
Oxygen	O	Zinc	Zn	Chlorine	Cl
Fluorine	F	Nitrogen	N	Copper	Cu
Iron	Fe	Neon	Ne	Chromium	Cr
Phosphorus	P	Sodium	Na	Argon	Ar
Lead	Pb	Boron	B	Aluminum	Al
Sulphur	S	Beryllium	Be	Gold	Au
Silicon	Si	Bromine	Br	Silver	Ag

Give reason:

1- Scientists agreed to express the chemical elements by certain symbols .

- **To facilitate their expression and writing, especially in chemical equations.**

Mass number(A) : the sum of number of positive protons(P) and number of neutral neutrons (n) in the nucleus.

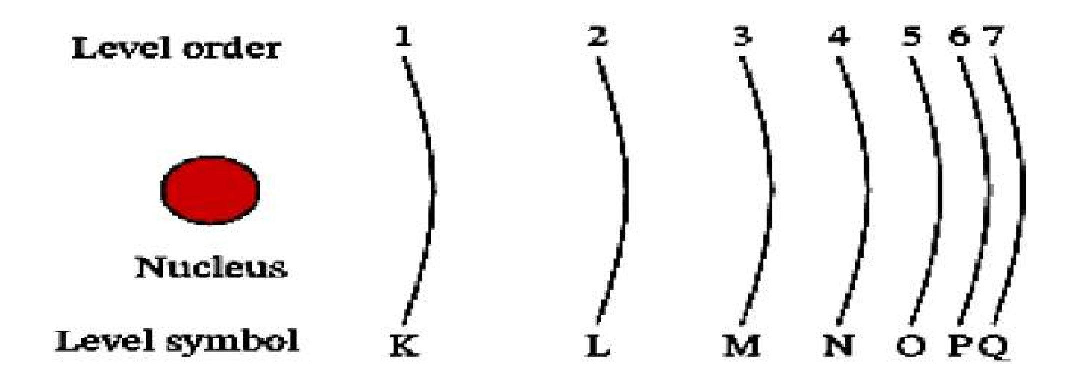
Atomic number (Z): the number of positive protons (p^+) Or the number of negative electrons (e^-)

To calculate the number of neutrons :

*** Mass number (A) - atomic number (Z)**

*** Number of nucleons = mass number (A)**

-The energy levels: They are imaginary regions around the nucleus in which the electrons move according to their energies.

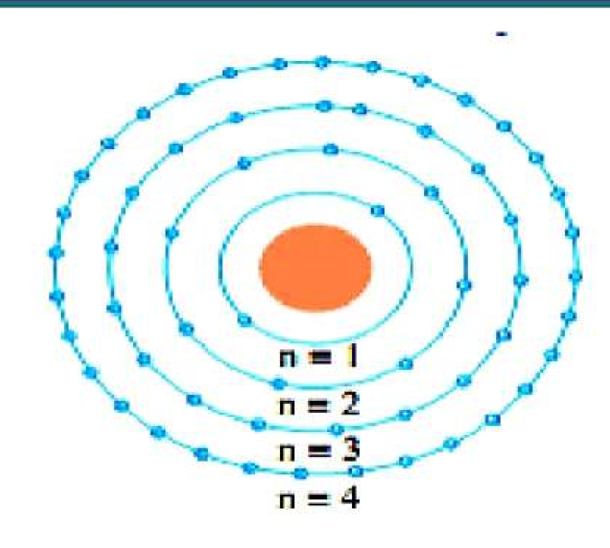


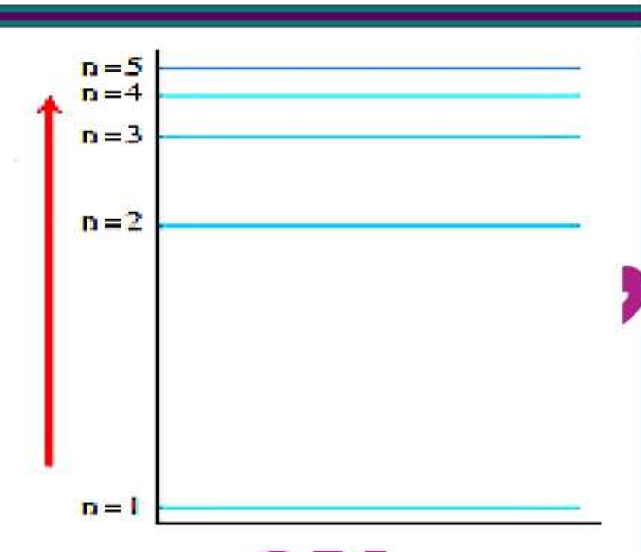
-They are 7 energy levels in the heaviest atom represented by:

K, L, M, N, O, P, Q

-As we go up from level 1 (K) to level 2 (L) the energy increases and so on.

Note: the number of protons may equal the number of neutrons in the nuclei of some atoms or the number of neutrons may exceed the number of protons in the nuclei of other atoms.





-**The no. of electron which saturates the first four energy levels can be calculated from relation $2n^2$ (n : number of energy level) so:**

The no. of electrons in energy level :

(k) =2× (1) 2 =2 **(L)=8**

(M)=18 **(N)=32**

- Each main energy level contains some energy sublevels.

- The outer most energy level of any atom can't take more than 8 electrons except (k) which saturated with (2) electrons.

Example:

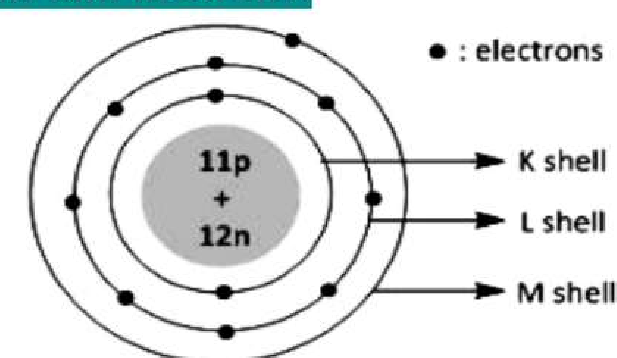
Write the electronic configuration of the following and mention the number of electrons ,protons and neutrons:

1- Sodium $^{23}_{11}Na$

No. of electrons :11

No. of protons :11

No. of neutrons = 23-11 =12



2- Chlorine$^{35}{}_{17}$C

No. of electrons :17

No. of protons :17

No. of neutrons = 35-17 =18

3-Nitrogen $_{7}^{14}$N

No. of electrons = 7

No. of protons =7

No. of neutrons = 14 -7 =7

4-Calcium $_{20}^{40}$Ca

No. of electrons = 20

No. of protons =20

No. of neutrons = 40-20=20

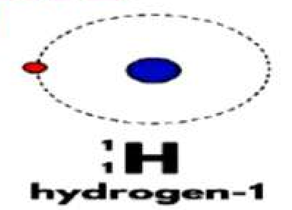
Isotopes: they are different forms of the same element have the same number of protons but different numbers of neutrons, leading to differences in atomic mass.

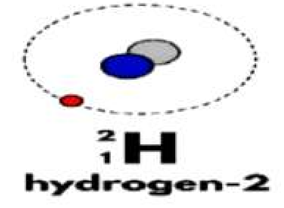
Example (1): Hydrogen has 3 isotopes:

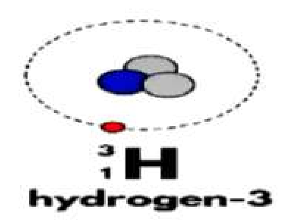
1-Hydrogen-1 (Protium): The most abundant isotope, it has only one proton in its nucleusand no neutrons.

2-Hydrogen-2 (Deuterium): It has one proton and one neutron in its nucleus.

-Hydrogen-3 (Tritium): It has one proton and two neutrons in its nucleus.







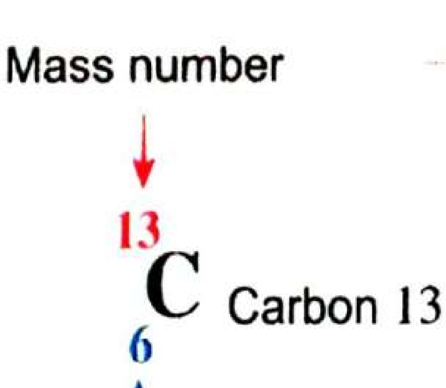
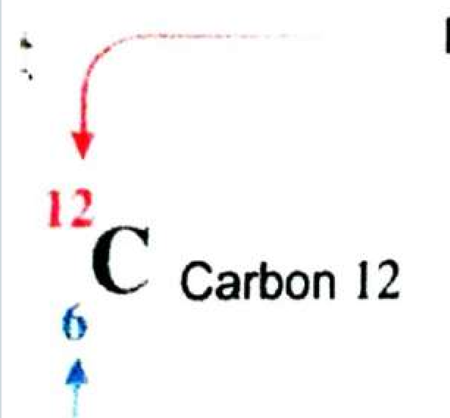








Example (2): carbon has 3 isotopes:

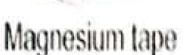




Example (3): Magnesium has 3 isotopes:

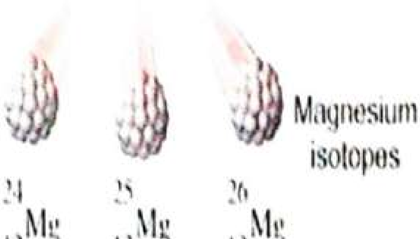
Magnesium Mg has 3 isotopes :

- Magnesium – 24 , It's symbol $^{24}_{12}Mg$
- Magnesium – 25 , It's symbol $^{25}_{12}Mg$
- Magnesium – 26 , It's symbol $^{26}_{12}Mg$

How many nucleons are found in the nucleus of each magnesium atom isotope?



Magnesium tape









What is the only hydrogen isotope that does not have neutrons in its nucleus? *Protium* $_1H^1$

G.R. isotopes of the element differ in mass number?

Due to the difference in the numbers of neutrons in the nuclei of the element's isotopes.

Check your understanding

The elements	(1)	(2)	(3)	(4)	(5)
The protons	20	16	16	7	8
The neutrons	20	20	18	8	9

Which two atoms represent two isotopes of the same element?

....

Life application

Fertilizers:

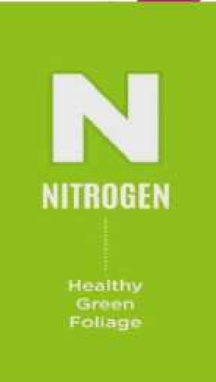
- They are chemical compounds used to improve crop yield.
- Fertilizers are composed of three compounds containing these elements.
- NPK fertilizer is one of the most important types of fertilizers.

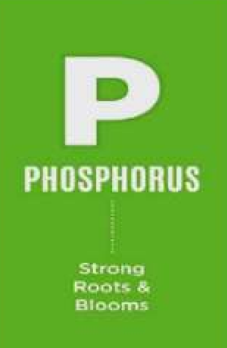


-Nitrogen (N): healthy green colour.

-Phosphorus (P): strengthen the roots.

-Potassium(K): healthy plant growth.









Worksheet (1)



Q.1) Write the scientific term:

1- Anything that has mass and occupies a space. ( )

2- The building unit of matter. ( )

3- An element involved in the composition of fertilizers, necessary for strengthening roots.

( )

4-The total number of protons and neutrons in the nucleus of an atom. ( )

5-Negatively charged particles that revolve around the nucleus at high speeds.

6- Positively charged particles found inside the nucleus of an atom. ( )

7-Neutral particles found inside the nucleus of an atom. ( )

8-The difference between the mass number and the atomic number in the nucleus of an atom. ( )

9- They are different forms of the same element have the same number of protons but different numbers of neutrons. ( )

Q.2) Choose the correct answer :

1-What is the smallest subatomic particle in terms of mass?

a-proton b-electron c-neutron d-nucleus

2-The nucleus of an atom carries ………….

a-positive b-negative c-neutral d-no charge

3- Which of the following elements is not a component of NPK fertilizer?

a-Phosphorus b- Sodium c- Nitrogen d- Potassium

4- The number of protons in lithium atom ${}^{7}_{3}Li$ is equal …………

a-7 b-4 c-3 d-10

5-The symbol of sodium atom is……………..

a-So b-Na c-Ar d-Hg

6- The number of energy level in the heaviest atom =…………..levels.

a-3 b-5 c-7 d-8

7- The last energy level saturated by……………….electrons, except the K level.

a-2 b-8 c- 18 d- 32

8- The atomic number of an element $^{40}_{18}Ar$ is……………….

a-18 b-40 c-32 d-15

9- Which of the following subatomic particles has a mass of 1 U ?

a-Protons only b-Electrons only

c-neutrons and electrons d-neutrons and protons

10- All atoms of the same element agree in………………

a-Mass number b-number of electrons

c-number of neutrons d-number of nucleons

Q.3)Write the symbols of the following :

1- oxygen :……………. 2-hydrogen :…………

3-iron:…………… …. 4-silicon:……………….

5-carbon:………….. 6-Sodium:………………



Q.4) The opposite figure represents an atom (X)

What is the symbol of this element ………

a- $_{12}^{6}X$ b- $_{4}^{4}X$ c- $_{6}^{13}X$ d- $_{6}^{6}X$

Q.5) Problems:

1-An element has 3 energy levels; the outermost energy level contains 3 electrons and the nucleus has 14 neutrons.

Calculate 1-the atomic number.

2-mass number.

……………………………………………………………………………………………..

……………………………………………………………………………………………..

2-Element (Y) its nucleus has 20 neutral particles and mass number = 39,

Calculate :

a- No. of negative charged particles.

b- Write the symbol of this element and mention number of A and Z

…………………………………………………………………………………………………

……………………………………………………………………………………………………..

Q.6) Write the electronic configuration of the following:

1- $^{39}_{19}K$



2- $^{27}_{13}Al$

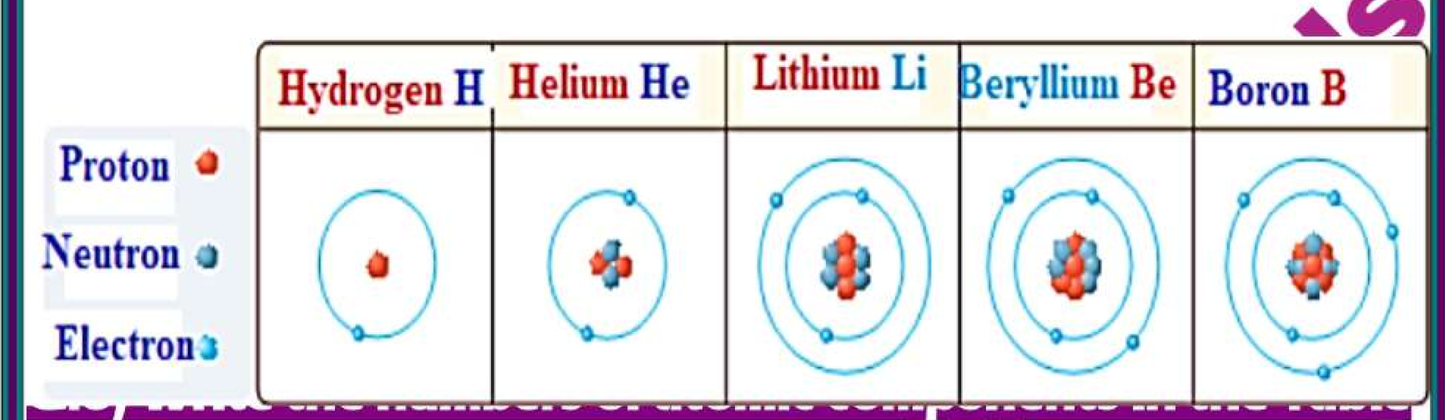
3- $^{20}_{10}Ne$





Q.7) In the opposite figure:





and choose the appropriate mathematical sign (= ,< , >) to express the appropriate relationship between:

The elements	$_1H^1$	He	Li	Be	B
No of **protons**					
No of **neutrons**					
No of **Electrons**					
The relationship between the numbers of **protons and electrons**	p…..e-	p…..e-	p…..e-	p…..e-	p…..e-
The relationship between the numbers of **protons and neutrons**	p…..n	p…..n	p…..n	p…..n	p…..n

LESSON (2) Atomic Structure

Scientist classified elements according to their properties in order to:

1- Facilitate their study.

2 -Find a relationship between physical and chemical properties of elements.

The most important attempts to classify elements are:

- Mendeleev's Periodic table
- Moseley's periodic table
- Modern periodic table.

Mendeleev's periodic table

- **It is considered the first real attempt to classify elements.**
- **Mendeleev arranged the elements according to <u>atomic masses.</u>**
- **He arranged the elements in vertical columns known as (groups) and from the left to right in horizontal rows known as (periods)**
- **He discovered that the properties of elements are repeated regularly at the beginning of each period**

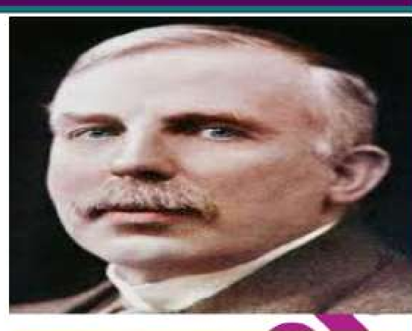


I	II	III	IV	V	VI	VII	VIII		
H 1.01									
Li 6.94	Be 9.01	B 10.8	C 12.0	N 14.0	O 16.0	F 19.0			
Na 23.0	Mg 24.3	Al 27.0	Si 28.1	P 31.0	S 32.1	Cl 35.5			
K 39.1 / Cu 63.5	Ca 40.1 / Zn 65.4		Ti 47.9	V 50.9 / As 74.9	Cr 52.0 / Se 79.0	Mn 54.9 / Br 79.9	Fe 55.9	Co 58.9	Ni 58.7
Rb 85.5 / Ag 108	Sr 87.6 / Cd 112	Y 88.9 / In 115	Zr 91.2 / Sn 119	Nb 92.9 / Sb 122	Mo 95.9 / Te 128	I 127	Ru 101	Rh 103	Pd 106
Cs 133 / Au 197	Ba 137 / Hg 201	La 139 / Tl 204	Pb 207	Ta 181 / Bi 209	W 184		Os 194	Ir 192	Pt 195
			Th 232		U 238				

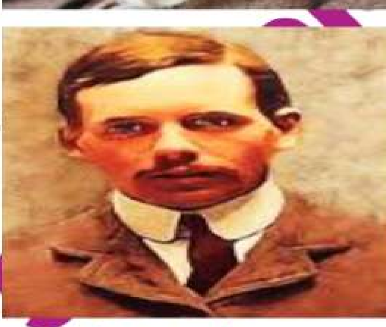


Mendeleev was honored by naming one of the discovered elements by his name called <u>Mendelevium</u> (Md).

2- Moseley's periodic table



Rutherford: discovered that the nucleus of an atom contains **positively charged protons** and their number is known as **atomic number**.

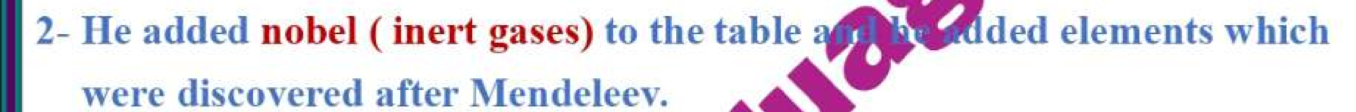


*** Moseley:** discovered that the properties of elements related to their ***atomic number*** not their ***atomic masses.***

So Moseley:



1- He arranged elements in ascending order according to their atomic Number .



2- He added **nobel (inert gases)** to the table and he added elements which were discovered after Mendeleev.

Give reason: **Mosley arranged elements according to atomic number.**
Because the properties of elements related to their atomic number not their atomic masses.

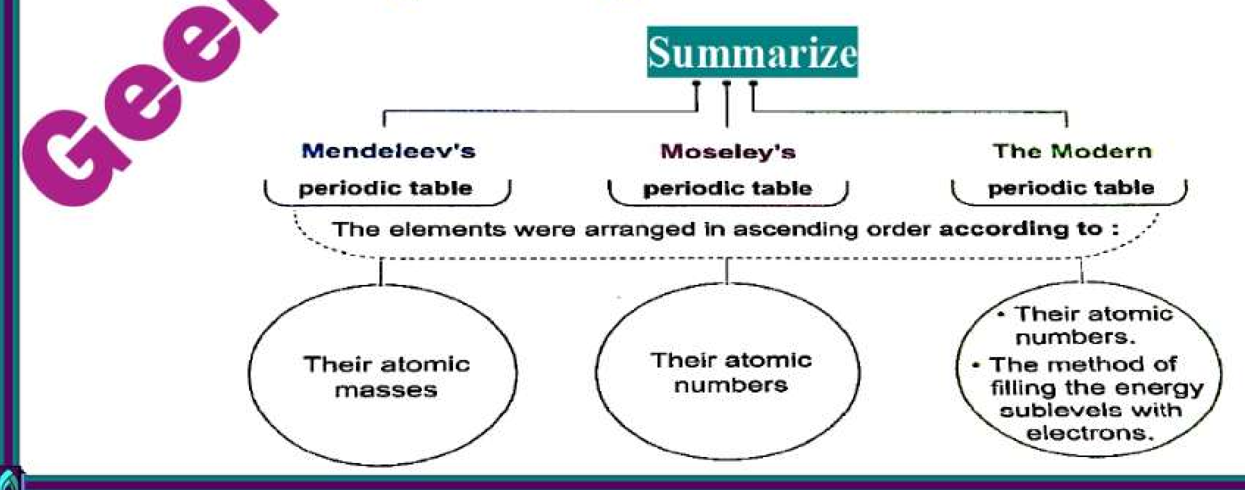
3- Modern periodic table

*** Elements are classified in the modern periodic table in an ascending Order according to:-**

**** Their atomic numbers.***

**** The way of filling the energy sublevels with electron.***

Summarize

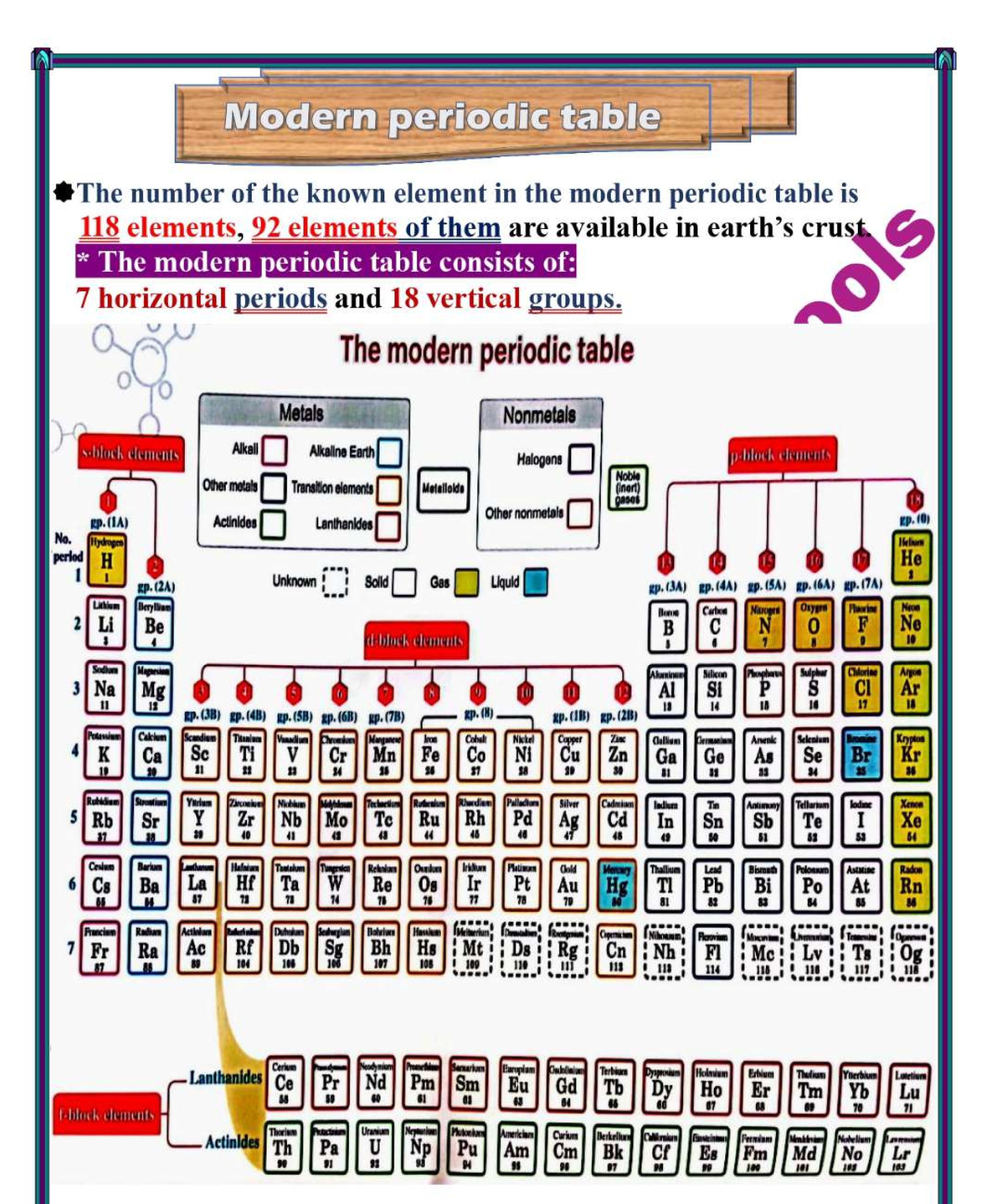


Modern periodic table

- The number of the known element in the modern periodic table is **118 elements**, **92 elements of them** are available in earth's crust.

*** The modern periodic table consists of:**

7 horizontal periods and 18 vertical groups.



* How many elements are in each of the first four periods

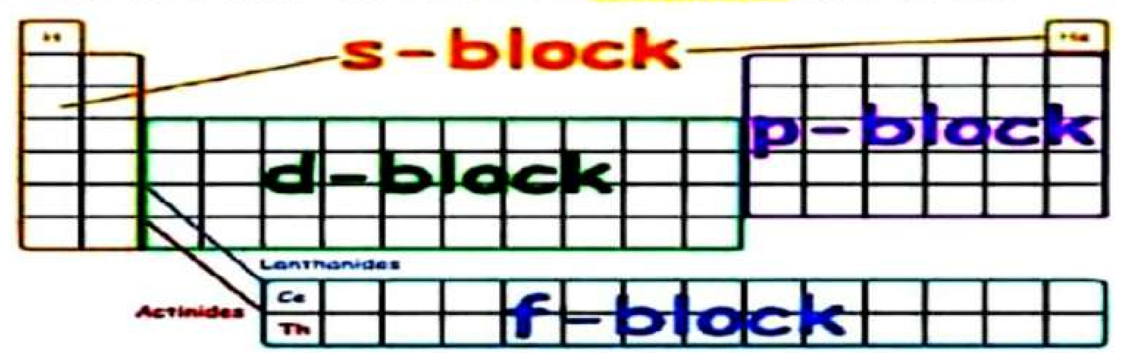
Period number	1	2	3	4
Numbers of elements	2	8	18	18

Classification of elements according to their physical state

Solid	Liquid	Gas
Most of elements are solid Li , Na , C , P , Fe	Mercury (Hg) (metal) Bromine (Br) (nonmetal)	Inert gases (He, Ne , Ar, Kr , Ze ,Rh) Active (nonmetal) gases (H , O , N , Cl , F)

Blocks of modern periodic table:

Modern periodic table consists of **4 blocks** S, P, D, F



1-S-block element:-

*located on the left side.

*Includes two groups, takes letter (A) which are (1A & 2A)

Group→ / ↓Period	1	2
1	1 H	
2	3 Li	4 Be
3	11 Na	12 Mg
4	19 K	20 Ca
5	37 Rb	38 Sr
6	55 Cs	56 Ba
7	87 Fr	88 Ra

Group (1A)	Group (2A)
They are solids except hydrogen is gas. They are all metals. They have one electron in the outer most energy level. They are called alkali metals. Example: Na $_{11}Na$))) 2 8 1	They are solids. They are all metals. All of them have two electrons in the outer most energy level. They are called alkali earth metals Example: Mg $_{12}Mg$))) 2 8 2

2- P –block elements:-



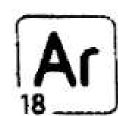
13	14	15	16	17	18
					2 He
5 B	6 C	7 N	8 O	9 F	10 Ne
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo

- Located on the right side of the periodic table.
- All groups take letter A except Zero group (Group 18) nobel gases
- It consist of six groups (3A,4A,5A,6A, 7A and zero groups) which take number (13,14,15,16,17and18) in the modern numbers.
- They are solid or gases except bromine (Br) is liquid non metal.

Group 7A (penultimate group)	Group18 (zero group)
They have 7 electrons in the outer most energy level so They are non-metals. They are called Halogen Example: chlorine ($_{17}Cl$)	Their outermost energy level is filled with 8 electrons except helium has two electrons. *They are called inert gases (Nobel gases). Example: argon ($_{18}Ar$)



2 , 8 , 7



2 , 8 , 8

Note

$_{15}P$ 2 . 8 . 5

$_{10}Ne$ 2 . 8

$_{13}Al$ 2 . 8 . 3

2- P- block element include:-

Metals as $_{13}Al$, nonmetals as $_{15}P$, nobel (inert gases) as $_{10}Ne$

It also includes all metalloids which can' t be identified from their outermost electrons due to difference in number valence electron.

Metalloid

Elements combine between metals and nonmetal properties

Metalloid	Boron (B)	Silicon (s)	Germanium (Ge)	Arsenic (As)	Antimony (Sb)	Telerium (Te)
Period	2	3	4	4	5	5
Group	3A	4A	4A	5A	5A	6A
Number of outer most electrons	3	4	4	5	5	6

d-block elements:-



- Located in the middle of the periodic table between (s, p) blocks (the left side of the periodic table).
- Contain 10 groups.
- They start to appear from period (4).
- Its elements all metals.
- They are called transition metals.





4- F- block elements:-

- They are located at the bottom of the periodic table.
- All of them are metals.
- It includes lanthanides and actinides.



s-block ?　　d-block ?　　p-block ?

H	He																	
Li	Be												B	C	N	O	F	Ne
Na	Mg												Al	Si	P	S	Cl	Ar
K	Ca		Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr		Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	★	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	★	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							

f-block ?

★	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
★	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No

Types of element according to electrons in the outermost energy level:

Metals	Non-metals	Inert gases	Metalloid
Contain 1,2,3 Electrons.	has 5,6,7 electrons.	Have 8 except Helium contain 2 electrons.	Have different numbers of electron.

Note

All periods start with metal and end with inert gas except period one starts with hydrogen which is nonmetal.

*Element of the same group:-

They have the same number of electrons in the outer most energy level

*Element of the same period:-

They have the same number of energy levels.

Give reason:-

Elements of the same group have similar properties.

Because **they have the same number of electrons in the outer most energy level**

How to determine the location of an element in the periodic table:

Period number = number of energy levels occupied by electron.

Group number = number of electrons in outermost energy level .

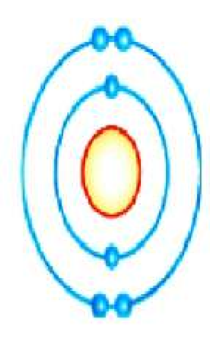
Period (3) $_{18}Ar$

Group (zero , 18)

2 8 8

:xample:

- Element X its atomic number = 6
- The atomic number of element follows it in the same period = 7
- The atomic number of element follows it in the same group = 14





In the same group:- **atomic number of element increases from the preceeding element by 8 electron except lithium increases by (2) electrons.**

In the same period:- **the atomic number of an element increases from an element preceeding it by (1) electron.**



Element	Electronic configuration	Number of energy levels occupied by electrons	Period number	Number of electrons in the outermost energy level	Group number		Block
					Traditional	Modern	
$_{8}O$	(+8) K L: 2 6	2	2	6	6A	16	p-block
$_{10}Ne$	(+10) K L: 2 8	2	2	8	zero	18	p-block
$_{12}Mg$	(+12) K L M: 2 8 2	3	3	2	2A	2	s-block
$_{2}He$	(+2) K: 2	1	1	2	zero	18	p-block

Valence electron:- are electrons in the last energy level.

Valency of the element:- can be determined from the number of the unpaired electrons in its Lewis structure.

Lewis dot structure: the electrons of outermost energy level are represented first by individual points at the four sides of element, then duplicated until all electrons are distributed

Group no.	1A	2A	3A	4A	5A	6A	7A	0
The element	Li	Be	B	C	N	O	F	Ne
Valency	Monovalent	Divalent	Trivalent	Tetravalent	Trivalent	Divalent	Monovalent	0



Determination of element valency by using Lewis dot structure:

1- From (1A -4A): valency of element is represented by number of individual electrons and equals number of its group

No. of valency = no. of electrons in outermost energy level = no. of its group.

2- From (5A – 0):

No. of valency = 8 – no. of electrons in outermost energy levels



The electronic configuration and properties of elements

The chemical properties of elements depend on the number of electrons in the outermost energy level, while the physical properties depend on the number of neutrons.

In (group 1A)

Alkali metals	Atomic radius	Melting point	Boiling point
Lithium $_{3}^{7}Li$ (2, 1)	157 pm	181 ^{0}C	1347 ^{0}C
Sodium $_{11}^{23}Na$ (2, 8, 1)	191 pm	98 ^{0}C	883 ^{0}C
Potassium $_{19}^{40}K$ (2, 8, 8, 1)	235 pm	64 ^{0}C	774 ^{0}C
	increases	decreases	decreases

-Atomic number increases from up to down which results in:

1- Increasing the atomic radius.

2- Decreasing melting and boiling point of alkali metals.

In group (7A) Halogen:-

Halogens	Atomic radius	Melting point	Boiling point
Chlorine $_{17}Cl$ (2, 8, 7)	99 pm	-110 ^{0}C	-34 ^{0}C
Bromine $_{35}Br$ (2, 8, 18, 7)	114 pm	-7 ^{0}C	59 ^{0}C
Iodine $_{53}I$ (2, 8, 18,18, 7)	133 pm	114 ^{0}C	184 ^{0}C
	increases	increases	increases

-Atomic number increases from up to down which results in:

1-atomic radius increases

2-melting and boiling point increases

Note

The atomic radii of elements in the same group increase as the atomic number increase.

Physical property	Melting point	Boiling point
solid	more than 25 ^{0}C	
liquid	Less than 25 ^{0}C	More than 25 ^{0}C
gas	Less than 25 ^{0}C	

Give reason:-

1-The melting and boiling points of lithium and potassium are higher than room temperature.

Because both are solid elements at room temperature.

2- The melting and boiling point of chlorine are lower than room temperature.

Because it is a gaseous element at room temperature.

Chemical activity

In alkali metals (group 1A) and alkali earth metals(group 7A).

Chemial activity increases from up to down by increasing atomic number.

- **Activity of alkali earth metal is less than alkali metal**
- **Cesium is the most active metal in the periodic table.**

In halogen (group 7A)

- **Chemical activity decreases from up to down by increasing atomic number.**
- **Fluorine is the most active nonmetal.**

In Inert or nobel gases (group18 or 0)

They are chemically inactive .does not share in chemical reactions.

Physical state of some halogen and alkali metals

Element	Physical state
Sodium	Solid
Potassium	Solid
Lithium	Solid
Chlorine	Gas
Bromine	Liquid
Iodine	Solid

Worksheet (2)



Q. 1-Choose the correct answer:-

1-What is the name of the element that was named in the honor of Mendeleev?

a-Mendelevium (Md) b-Moselium (Ms)

c- Rutherfordium (RF) d-Mendelium (Me)

2-Who is credited with the first real attempt to classify the element?

a-Moseley b- Rutherford c-Mendeleev d-Einstein

3-How many horizontal periods are in the modern periodic table?

a-5 b-6 c-7 d-8

4-How many vertical groups are in the modern periodic table?

a- 12 b-15 c-16 d-18

5-Which of the following is solid element?

a- Helium b-neon c-carbon d- Oxygen

6- Which of the following is the only liquid metal?

a- Silver b- mercury c- bromine oxygen

7-How many electron do halogen have in their outermost energy level?

a-7 b-5 c-6 d-9

8-What is the valency of an element in group 3A?

a-1 b-3 c-4 d-5

9- Which period does transition metal start to appear?

a-3 b-4 c-5 d- 6

10-What is the common name of group (1A)

a- Alkali earth metal b- alkali metal

C -Transition element d- inert gases

Q.2 Write the scientific term:-

1-The element found in the middle section of the periodic table between the S and P block. (……………….)

2-The most active metal found in group 1A of the periodic table. (……..……….)

3- Elements combine in their properties between metals and non-metals (……………….)

4-Gases found at the last group and don't share in chemical reaction. (……….........)

5- The property which Mendeleev depends on in his table. (..…………….)

Q.3 The following figure illustrates some groups of the periodic table :

A	B			C	D

Which of the following is correct about the elements in these groups ?

(a) Group (A) : Monovalent nonmetals.

(b) Group (B) : Their atomic radii decrease with increasing the atomic number.

(c) Group (C) : The physical states of its elements are not the same.

(d) Group (D) : Octavalent nonmetals.

Q.4 Give reason:-

1- Scientists have made many attempts to classify the elements.

………………………………………………………………………………………
……………………………………………………………………………………

2- Hydrogen is placed in group 1A.

………………………………………………………………………………………
……………………………………………………………………………………



3-The melting and boiling point of alkali metals decreases as you move down the group.

…………………………………………………………………………………………
…………………………………………………………………………………………

4- Sodium and potassium have similar chemical properities.

…………………………………………………………………………………………
……………………………………………………………………………………

5- Moseley's periodic table is based on atomic number rather than atomic masses.

…………………………………………………………………………………………
……………………………………………………………………………………

Q.5] section in the modern periodic table :

																1	
2												3					
4																	

(1) Which two elements are in the same period ?
(2) Which two elements are in the same group ?

Q.6 Locate each of the following element , then mention their types:-

1- Na_{11} ……………………………………………………………………..

2- Ne_{10}……………………………………………………………………

3-O_8………………………………………………………………………..

LESSON (3) Matter and its properties

Substances are divided into:

1- Mixtures:

a- Homogeneous (solutions)

b- Heterogeneous (mixtures)

2- Pure substances:

a- Elements

b- Compounds

➢ **Mixtures:** are substances composed of two or more materials that are not chemically combined.

Mixtures can be separated by physical methods:

- filtration
- evaporation and condensation.
- Magnetic separation







Mixtures are divided into



P.O.C	Homogeneous mixture	Heterogeneous mixture
Definition	Mixture cannot be distinguished with the naked eye.	Mixture can be distinguished with the naked eye.
Separation methods	Its components can be separated by evaporation and condensation.	Its components can be separated by filtration.
Examples	Mixture of table salt in Water. Salt + Water = Saline water Table salt in water can be separated by: **evaporation & condensation** They are method used to separate components of a solution of a solid substances which is dissolved in water.	the mixture of Sand in water Sand + Water → Water + Sand Sand in water can be separated by: **Filtration** It is a method used to separate a solid substances which is not dissolved in water by using filter paper in a filtration funnel. Beaker Containing Mixture, Filter Paper, Residue, Funnel, Conical Flask, Filtrate

Remember All matter is composed of smaller units called molecules, which are composed of smaller units called atoms.

Pure substances:

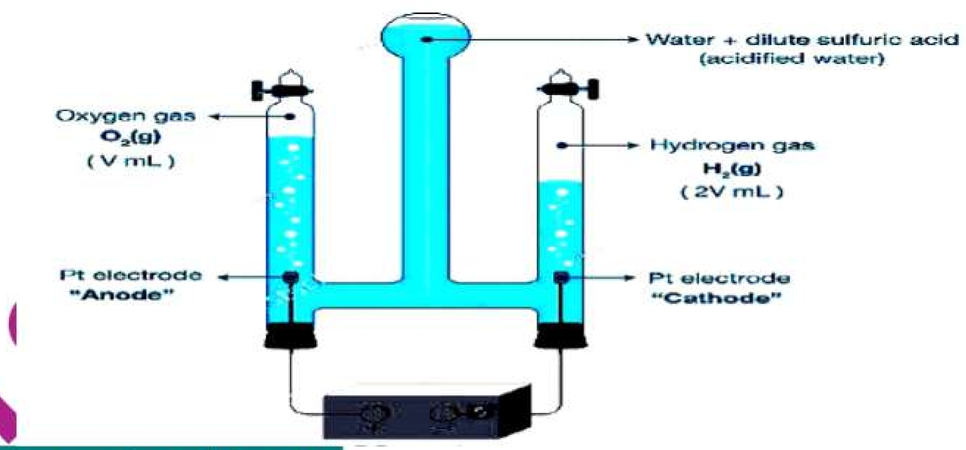
They are substance that cannot be separated by physical methods.

Pure substances are divided into:

Elements	Compounds
It is the simplest pure form of matter and cannot be dissociated into simpler forms, either by physical or chemical methods. **Examples:** 1-Mercury 2- Oxygen	✸They are formed by the chemical combination of two or more elements in fixed mass ratios. ✸They can be separated by chemical methods. **Examples :** 1-Water 2- Mercury oxide (red color) can be separated into (oxygen and mercury) by heating

The electrolysis separation of water

HOFMANN'S VOLTAMETER



Name : Hofmann's voltmeter

Usage : **Electrolysis water:** split water acidified with sulfuric acid into oxygen and hydrogen by using electricity)

Give reason: hydrogen is classified as an element.

➡Because it is the simplest pure form of matter and can't separate into simpler forms by using physical and chemical methods

Give reason: water is classified as a compound .

➡ **Because it is separated by electrolysis into oxygen and water.**

Give reason: pure water is considered Pure compound.

➡ **Because the components can be separated into oxygen and hydrogen.**



- Molecules of elements
  - Monatomic
  - Diatomic
  - Polyatomic molecule
- Molecules of Compounds
  - Organic molecules
  - Inorganic molecules

Molecules of elements:

Monatomic : consists of one atom as carbon (C)

Diatomic : consists of 2 atoms as Oxygen (O_2)

Polyatomic molecule : consists of more than two atoms as ozone (O_3)

Molecules of compounds:

P.O.C	Organic molecules (Carbon compounds)	Inorganic molecules
Definition	Chemical compounds in which carbon atoms bonded to hydrogen atoms and may also be bonded to other atoms as oxygen and nitrogen.	compounds which contains various, including carbon in some cases.
Examples	1- Methane contains C& H 2-Organic contains C,H,O 3- Organic contains C, H, N CH4 METHANE	5- Nitric acid 6- Carbon dioxide Nitric Acid HNO_3

	Methane molecule	Nitric acid molecule
Type of molecule	Organic compound molecule	Inorganic compound molecule
Molecular formula	CH_4	HNO_3
Number of elements in the molecule	Two elements: Carbon and hydrogen	Three elements: Hydrogen, nitrogen and oxygen
Number of atoms in the molecule	1C + 4H = 5 atoms	1H + 1N + 3O = 5 atoms

Give reason: Organic compound is called carbon compunds.

Due to the presence of carbon el ement the main component.

❖ What is a chemical formula ?

A combination of symbols and numbers that represent the number and types of elements (atoms) present in a compound like NH_3

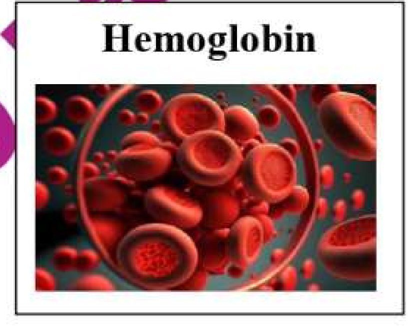


- ✓ **A chemical formula tells us the number of atoms of each element**
- ✓ **The number of atoms in one molecule in some compounds may reach several thousand like :**

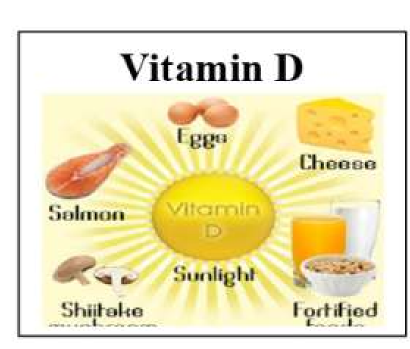
Plastic polymers



Hemoglobin



Vitamin D



Vitamin D: regulates calcium and phosphorus levels to protect against osteoporosis.

❖ Life application :

-Indigo blue dye -Chemical formula: CaCuS14O10

- Usage :

- ✸ The ancient Egyptians used it to color papyri and statues.
- ✸ It is still used to color the facades of houses in Nubia villages.



P.O.C	Physical properties	Chemical properties
Definition	They can be observed and measured in some cases.	They only appear when chemical reaction occurs causing a change in the shape and structure of substance.
Examples	1- The difference in density like that between cork and iron. Cork Iron Ball Iron ball sinks while cork floats in water 2- The difference in viscosity like that between honey and water. Viscosity Viscosity is a measure of a fluid's resistance to flow. Water Lower Viscosity 1.0 centipoise Honey Higher Viscosity 12,200.0 centipoise 3- The difference in the melting point on a block of butter and aerogel sheet	1-The difference in color of litmus paper like in lemon juice from its color in toothpaste. 2- The difference in the color of th 3- e solid precipitate formed by adding a single reagent to two different solutions. Blue solution / Green / yellow ppt / Orange red ppt / Brick-red ppt None / Traces of reducing sugar / Moderate / Large amount of reducing sugar

Substances	Properties	Uses	Illustrations
Helium	1- Inert gas 2- Less dense than air 3- Non- flammable	- It is used to fill balloons	
Nitrogen	1- Nonmetal gas 2- It doesn't affect by temperature changes 3- It doesn't react with rubber	-it is to fill car tires instead of air	
Silicon	1- Metalloid 2- It conducts electricity poor than metals but better than nonmetals	-It is used in the manufacture of electronic chips	
Stainless steel alloy	1- Made from iron with added elements 2- It is resistant to rusting	-It is used to manufacture cooking utensils	
Aluminum – titanium alloy	1- It is Lighter aluminum 2- It retains its strength at high temperatures	-It is used to in the construction of military aircraft frames / structure	



TECHNOLOGICAL APPLICATIONS :

Name : Aerogel

Properties : it is transparent – low density solid materials – with high durability – it has excellent insulating properties

Uses : it is used in making jackets of researches in Antarctica instead of polar bear's fur

➢ **Give reason:** **Aerogel is the lightest solid materials.**

→ **Because air enters its composition by 99.8%, so it is low in density.**

Density is a physical property used to distinguish between materials that float on the surface of water and that sink in it.

* **The material that has a density less than the density of water floats on its surface.**
* **The material that has a density greater than the density of water sinks in its surface.**
* **Density of cork is less than water.**
* **Density of iron is greater than water.**

Melting point is a temperature at which the state of a **Substance starts to change from solid to liquid.**

Butter block melts easily by heat, while the aerogel sheet is not affected even by a high elevation in temperature.

Viscosity **is a physical property of liquids that describes their resistance to flow and the movement of objects through them.**

* **Water has lower viscosity than honey so it is easier to stir water than honey**



Worksheet (3)

Complete :

1- The components of a table salt solution can be separated by……..

2- .... Examples of monoatomic molecules

3- The number of atoms in one molecule may reach several thousand, such as......................

4- Of the substances that float on the surface of water ……………..

Give reason :

1- The vinegar solution is a homogeneous mixture

2- water is classified as a compound .

3- Celebration balloons and blimps are filled with helium gas





Lesson (4) Chemical bonds



The molecules of substances around us are different.

Difference in the physical and properties of compound molecules.

Ex:

Compound	Sodium chloride (NaCl)	Hydrogen chloride (HCl)
Physical state	Solid	Gas
Ability to react with caustic soda solution	Doesn't react	React

Types of chemical bonds

1- Ionic bond. **2- Covalent bond**

1- Ionic bond:

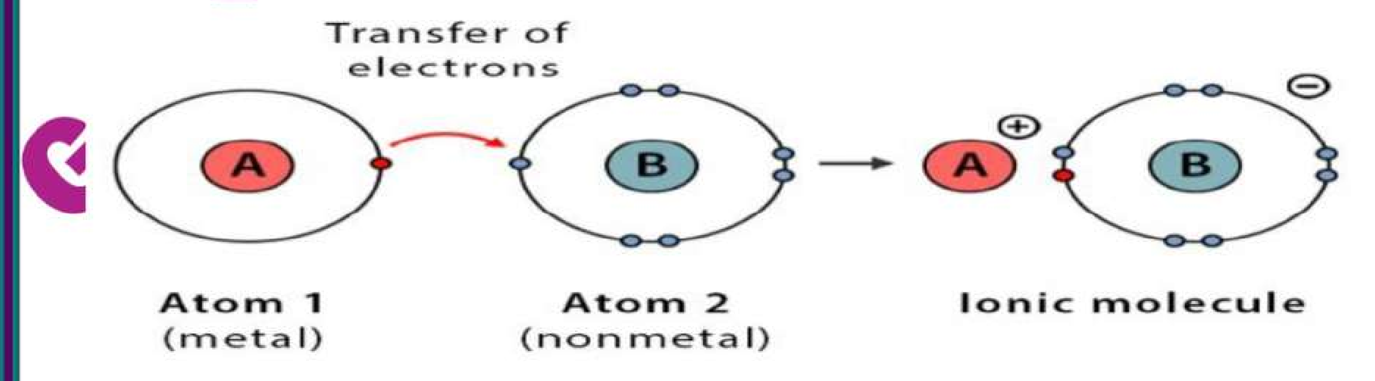
The electrostatic attraction between the cation (+ve ion) and the anion (-ve ion) forming ionic compound.

Note:

1-Ionic bond formed when metal react with non metal.

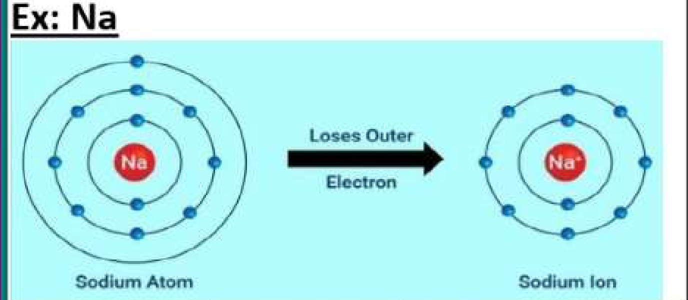
(the ionic compound is electrically neutral).

-Due to the equal number of positive and negative charge.

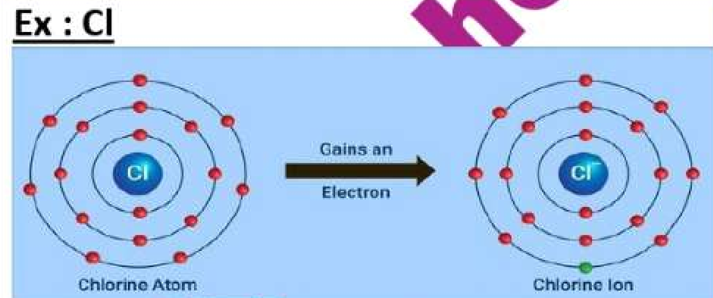


Role of metal and non metal in ionic bond:

Metal	Non-metal
Lose its valence electron ↓ Forming Positive ion. (Cation)	Gain electrons ↓ Forming Negative ion (anion)
(+) Charge of cation = no.of lost electrons	(-) Charge of anion= no.of gained electrons .
Ex: Na	**Ex : Cl**



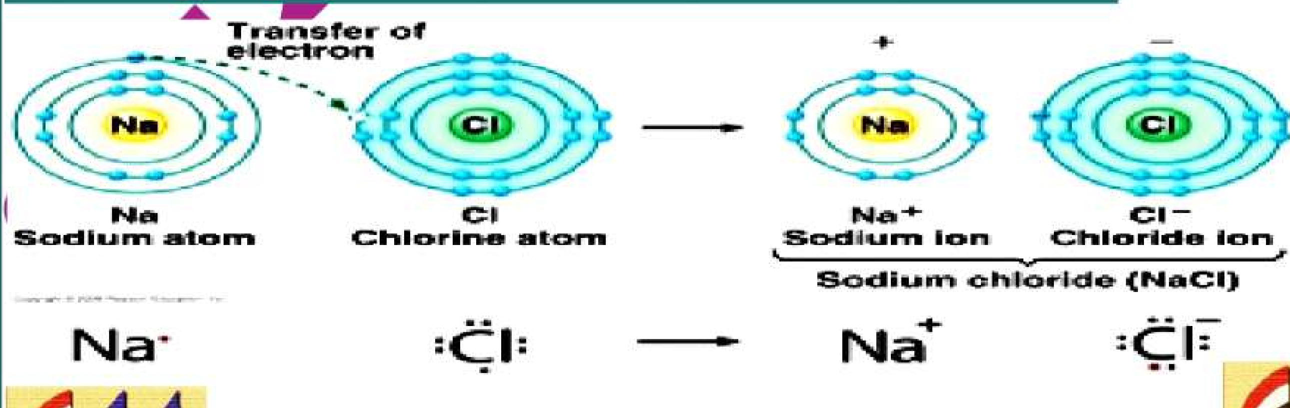
P.o.c	Na	Na^+ (cation)
No.of protons	11	11
No.of electrons	11	10
Electric charge	0 (no charge)	+1



P.o.c	Cl	Cl^- (anion)
No.of protons	17	17
No.of electrons	17	18
Electric charge	0 (no charge)	-1

-The electronic configuration of each of the cation and the anion is similar that of the nearest noble gas

Ex: formation of ionic bond between sodium and chloride



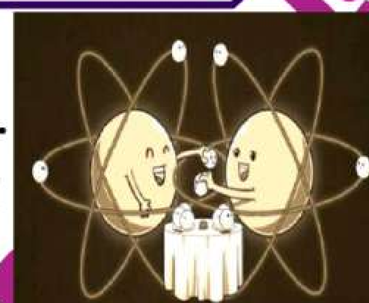




Molecular formula

-Formula which represents the number and type of atoms in a molecule.

How to write the molecular formula for ionic compound



1- Write the name of ionic compound

2- Write the symbol of each element in the compound.

3- Write the valence of each element below its symbol

4- Exchange the valence of them

Note:

- Write the cation at left side then the anion at right side.

Ex. Write the molecular formula for the following:

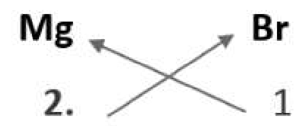
1- Magnesium oxide

Mg O

1 ~~2~~ ~~2~~ 1

Molecular formula = MgO

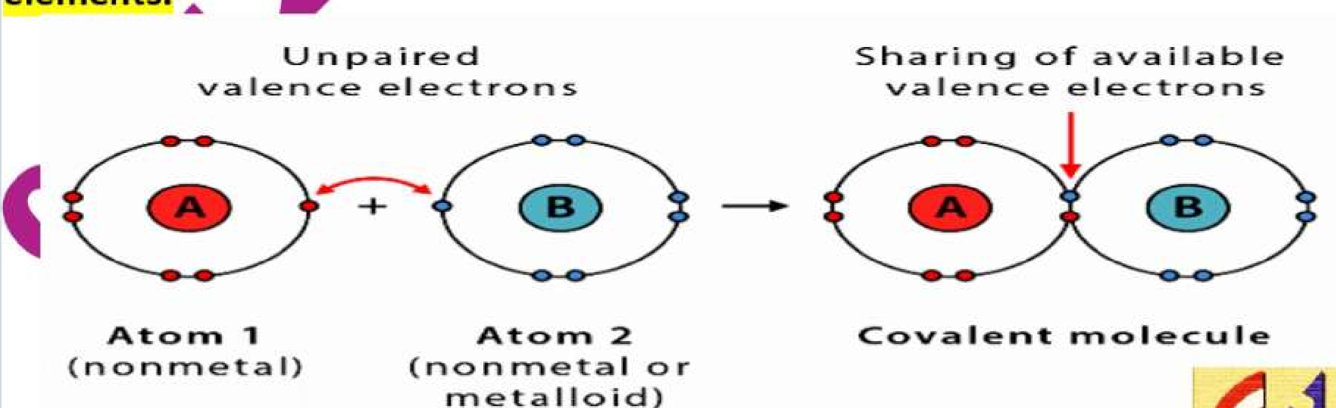
2-Magnesium bromide

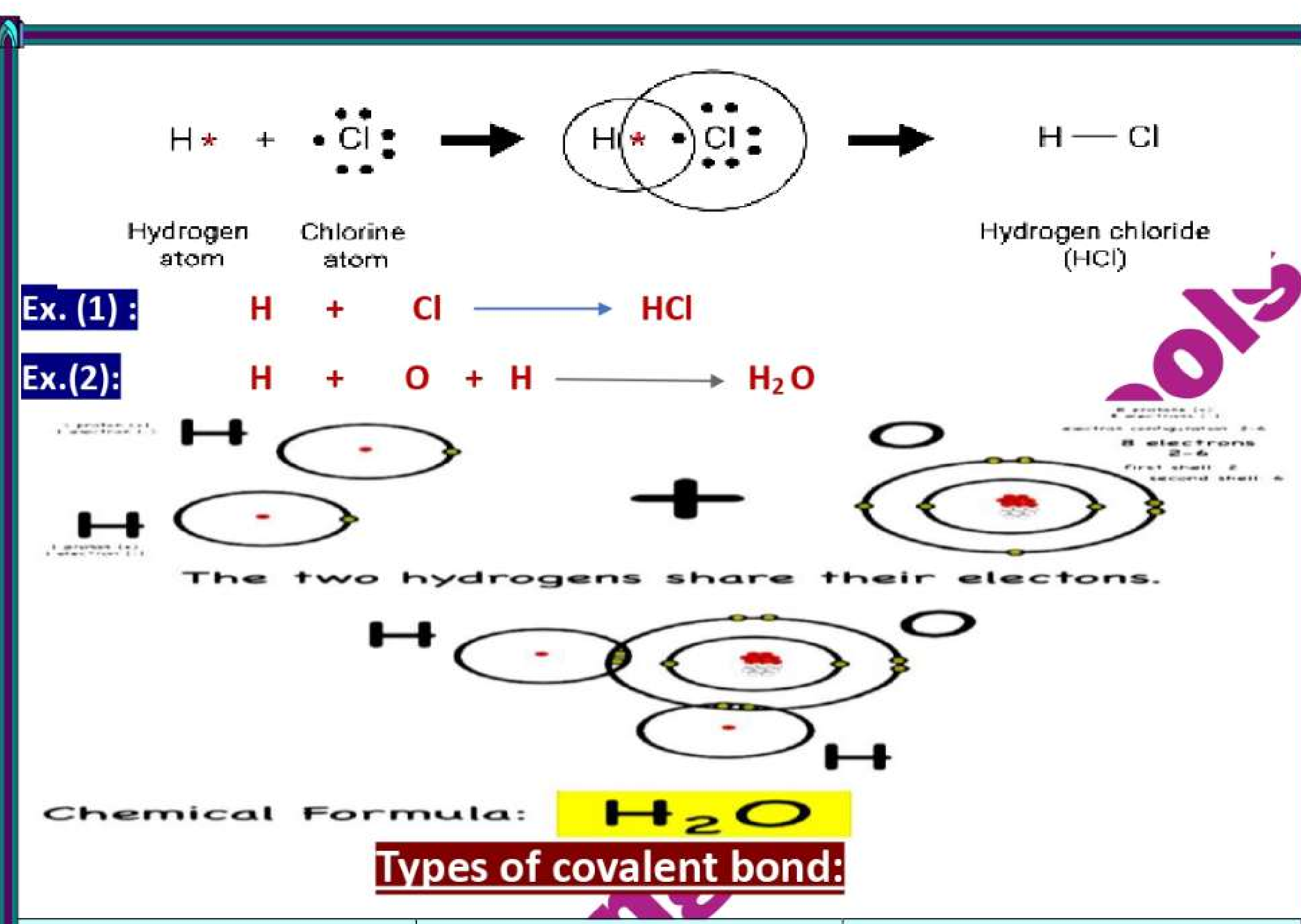


Molecular formula= $MgBr_2$

2- Covalent bond:

Chemical bond formed due to sharing the valence electrons among non-metal elements.





Ex. (1) : H + Cl → HCl

Ex.(2): H + O + H → H_2O

Types of covalent bond:

Single	Double	Triple
———	═══	≡≡≡
Ex. H_2	Ex. O_2	Ex. N_2
O=O O_2	Single covalent bond (H–H) →	N≡N

Difference between ionic compounds and covalent compounds

Ionic compounds	Covalent compounds
Dissolve in water	Don't dissolve in water
Conduct electricity	Don't conduct electricity
Have high melting and boiling point	Have low melting and boiling point.

Think

- Mention the type of bond in the following reaction?

CH_4 + $2O_2$ CO_2 + $2H_2O$

Unique properties of carbon as the main element in organic compounds :

1- Outer most energy level of carbon contains 4 electrons.

2- It has the ability to bind to each other in organic

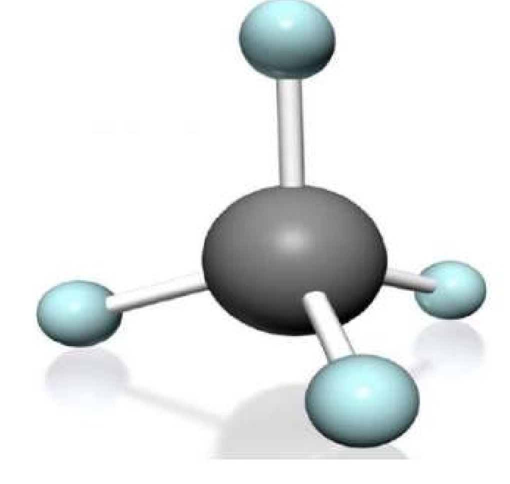
Compounds as in the forms of :

Straight chain	Branched chain	Cy e

Example on the simplest organic molecule is

Methane







Worksheet (4)

Question 1: choose the correct answer.

1-The atom charges to.................ion when it loses its outer electrons.

a) positive. b) negative. c) neutral

2- The of bond in sodium chloride molecule is............bond

a) covalent. b) ionic. c) neutral

3- What is the molecular formula of the compound formed through the bonding of alkali metal A with an element B from group 6A?

a)AB. b) A_2B. c) AB_2

4- What is the number of electrons in Cl^- is .... electrons

(The atomic number of Cl = 17)

a) 16 b) 17 c) 18

Question 2: write the scientific terms:

1- Electrostatic attraction between cation and anion. (.................................)

2- Chemical bond formed due to sharing the valence electrons among non-metal elements (............................)

3- they are formed when a metal losses it's electrons (...................)

Question 3: Compare between covalent and ionic .

Question 4:

- Water and methane are two known compounds.

1) Which of them is an organic compounds?

2) Explain how the atoms bind together in the inorganic compound using Lewis structu



Model answer

Worksheet (1)

Q.1) Write the scientific term:

1- matter. 2-atom 3-phosphorus 4-Mass number 5- electrons

6-protons 7-neutrons 8-no.of neutrons 9-isotopes

Q.2)Choose the correct answer :

1-b 2-a 3-b 4-c 5-b

6-c 7-b 8-a 9-d 10-b

Q.3)Write the symbols of the following :

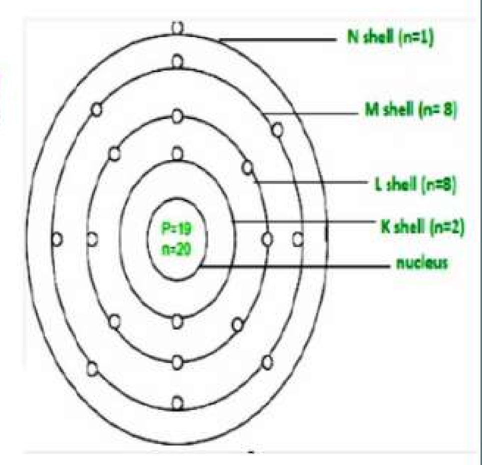
1-O 2-H 3-Fe 4-Si 5-c 6-Na

Q.4) c

Q.5) 1-No. of protons = no. of electrons = 2 + 8 + 3 = 13

Atomic no. = 13 Mass no. = 13+14 =27

2- a -No.of electrons = 39 -20 = 19 b- $^{39}_{19}Y$

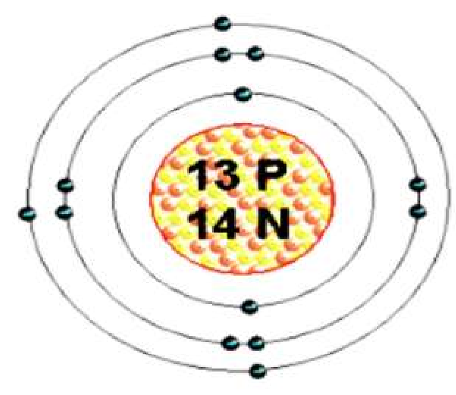


Q.6) Write the electronic configuration of the following:

1- no. of electrons = no. of protons = atomic no. = 19

Mass number =39

No.of neutrons = 39-19=20



2- no. of electrons = no. of protons= atonic no. = 13

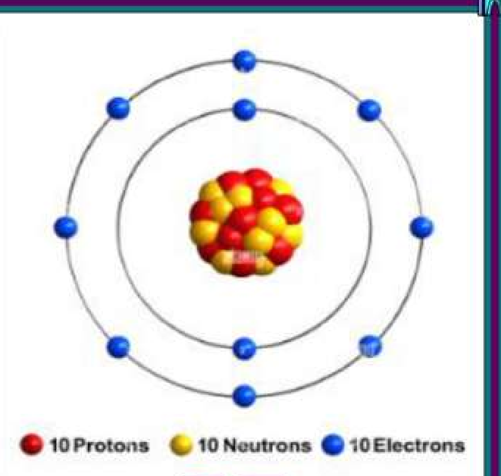
Mass number=27

No. of neutrons = 27-13=14

3-no. of electrons = no. of protons= atonic no. = 10

Mass number=20

No. of neutrons = 20-10=10



Q.7) In the opposite figure:

The element	H	He	Li	Be	B
No.of protons	1	2	3	4	5
No.of neutrons	0	2	4	5	6
No.of electrons	1	2	3	4	5
The relation between protons and electrons	P = e	P = e	P = e	P = e	P = e
The relation between protons and neutrons	P > n	P = n	P < n	P < n	P < n



Worksheet (2)

Q.1)

1- a   2-c   3-c   4-d   5-c   6-b   7-a   8-b   9-b   10-b

Q.2)

1-Transition element (d –block element)   2-cesium
3-metalloid   4- nobel (inert) gases   5- atomic mass

Q.3) (C)

Q.4)

1-facilitates their study and find a relationship between physical and chemical properties of elements.

2- Because it has only one electron in the outer most energy level.

3- Because they are similar in the electrons of the outer most energy levels

4- Because the properties of elements related to their *atomic number* not their atomic masses.

Q.5)

1- 2, 3   2- 2 ,4

Q.6)

1- Period (3)	group (1A)	Metal
2- Period (2)	group (0 or 18)	Nobel or inert gas
3- Period (2)	group (6A or 16)	Non metal



Worksheet (3)

Complete:

1-Evaporation 2- Carbon 3-Vitamin D 4- Cork

Give reason :

1- Because its components cannot be distinguished with the naked eye
2-Because, it's separated by chemical methods
3-Because its density is less than air

Worksheet (4)

Question 1: choose the correct answer

1- a Positive	2- b Ionic	3- b A_2B	4- c 18

Question 2:

1- Ionic bond	2- covalent bond	3- cation (positive ion)

Question 3:

Ionic compounds	Covalent compounds
Dissolve in water	Don't Dissolve in water
Conduct electricity	Don't conduct electricity
Have high melting and boiling point	Have low melting and boiling point

Question 4:

1- Organic compound is methane

2- Inorganic compound is water

it's molecules bond together by covalent bond

Lewis structure of water.

